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DNA FABRICATION, A WAKE UP CALL: THE NEED TO REEVALUATE THE ADMISSIBILITY AND RELIABILITY OF DNA EVIDENCE

Kristen Bolden*

INTRODUCTION

In June 2009, Israeli forensic science researchers published a ground breaking study that put credence to the possibility of creating artificial Deoxyribonucleic Acid (DNA) that can fool current forensic testing procedures.¹ The researchers asserted that anyone with the proper equipment and basic understanding of molecular biology could create artificial DNA in virtually unending amounts.² Furthermore, the research demonstrates that the current American forensic science system utilized by law enforcement is incapable of distinguishing between artificial and genuine DNA.³

DNA evidence first emerged in the 1980s and brought with it a new chapter of forensic science.⁴ The use of DNA evidence has led to hundreds of post-conviction exonerations⁵ and assisted in tens of

* J.D. Candidate, May 2011. The author would like to thank Professor Jessica Gabel for suggesting such a fascinating topic and for her insightful advice throughout the writing process.

1. D. Frumkin et al., *Authentication of Forensic DNA Samples*, FORENSIC SCI. INT. GENET. 1, 1 (2009). The researchers, working for Israeli forensic science company Nucleix, Ltd., published an article in Forensic Science International: Genetics on their discovery of the ability to fabricate DNA. *Nucleix Researchers Discover DNA Evidence May Easily Be Falsified*, CN PUBLICATIONS, Aug. 17, 2009, <http://cnpublications.net/2009/08/18/dna-evidence-may-be-falsified>.

2. Frumkin et al., *supra* note 1, at 1.

3. *Id.*

4. Joseph L. Peterson & Anna S. Leggett, *The Evolution of Forensic Science: Progress Amid the Pitfalls*, 36 STETSON L. REV. 621, 621, 630 (2007) (stating that “DNA typing is, without question, the single greatest forensic scientific breakthrough in the past century” and the 1980s was a period of major scientific breakthroughs for forensic science including the advent of DNA typing).

5. Brandon L. Garrett & Peter J. Neufeld, *Invalid Forensic Science Testimony and Wrongful Convictions*, 95 VA. L. REV. 1, 5 (2009) (“Two hundred thirty-two innocent persons have now been exonerated by post-conviction DNA testing.”). The Innocence Project at Cardozo Law School, which worked to free hundreds of wrongly convicted prisoners based on post-conviction DNA testing, as well as the publication of “a series of case studies recounting the experience of numerous prisoners exonerated by DNA testing who had been [wrongly] convicted” brought attention to the possible life-changing effect of this law enforcement tool. Peterson & Leggett, *supra* note 4, at 636–37.

thousands of investigations.⁶ In recent years, DNA evidence has been held as the “gold standard” of evidence,⁷ considered “the greatest forensic advancement since the advent of fingerprinting,”⁸ and likened to “the finger of God.”⁹ As the acceptability of DNA evidence has increased, so has the number of convictions resting solely on DNA evidence.¹⁰

DNA fabrication calls into question the reliability of DNA evidence used in the current forensic science and law enforcement systems. Part I of this note provides background on DNA,¹¹ the findings of the Israeli report,¹² the ease of fabricating and planting DNA,¹³ and DNA admissibility standards currently at use in United States courtrooms.¹⁴ Part II discusses DNA’s current admissibility as compared to newer forms of forensic evidence and the possible impact artificial DNA could have on the admissibility of DNA evidence.¹⁵ Ultimately, Part III proposes that all courts adopt the

6. Peterson & Leggett, *supra* note 4, at 653–54 (stating that profiles collected for the DNA database CODIS have “contributed to more than 36,000 criminal investigations”); *see also* RON C. MICHAELIS ET AL., A LITIGATOR’S GUIDE TO DNA 105 (2008) (stating that the DNA profiles from CODIS have led to over 21,000 identifications).

7. Peterson & Leggett, *supra* note 4, at 654 (stating that DNA evidence has replaced fingerprinting and is the “new ‘gold standard’ of forensic evidence”).

8. David Hensch, *Developing of DNA Database Falls Behind*, PORTLAND PRESS HERALD, Oct. 31, 1999, at A1 (quoting Lt. Michael Harriman, head of the Maine police crime lab).

9. *DNA Links Convict to 21-Year-Old Slaying Evidence Likened to “The Finger of God”*, THE RECORD (N.J.), Mar. 14, 2000, at A5, available at 2000 WLNR 7495855 (quoting Jeanine Pirro, Westchester District Attorney). After DNA evidence linked a convicted robber serving time in Sing Sing Correctional Facility to a 21-year-old unsolved murder, the District Attorney said that DNA evidence is “like the finger of God pointing down and saying, [y]ou can’t get away with it no matter how long it’s been.” *Id.*

10. *See generally* Brooke G. Malcom, *Convictions Predicated on DNA Evidence Alone: How Reliable Evidence Became Infallible*, 38 CUMB. L. REV. 313 (2008). *See, e.g.*, *People v. Rush*, 630 N.Y.S.2d 631, 634 (Sup. Ct. 1995), *aff’d*, 672 N.Y.S.2d 362 (App. Div. 1998) (finding that DNA evidence alone was sufficient for a conviction despite contradictory eyewitness testimony); *State v. Toomes*, 191 S.W.3d 122, 131 (Tenn. App. 2005) (finding that uncorroborated DNA evidence is sufficient to support the conviction of aggravated rape); *Roberson v. State*, 16 S.W.3d 156, 172 (Tex. App. 2000) (upholding the sexual assault conviction of a defendant based on DNA evidence alone); *Springfield v. State*, 860 P.2d 435, 453 (Wyo. 1993) (upholding a conviction of first degree sexual assault where only DNA evidence linked the defendant to the crime).

11. *See* discussion *infra* Part I.A.

12. *See* discussion *infra* Part I.B.

13. *See* discussion *infra* Part I.C.

14. *See* discussion *infra* Part I.D.

15. *See* discussion *infra* Part II.

Frye-Kelly standard of admissibility for DNA evidence as well as additional requirements in light of this new discovery.¹⁶

I. BACKGROUND

A. Introduction to DNA and its Use in Law Enforcement

DNA is “the hereditary material . . . [that] makes each living organism unique from all others.”¹⁷ DNA is considered a “genetic fingerprint” because it can be used to “identify and distinguish among individuals.”¹⁸ DNA technology first emerged in the 1980s and has played an important role in criminal investigations.¹⁹ In 1994, Congress passed the DNA Identification Act of 1994,²⁰ authorizing the creation of a Combined DNA Index System (CODIS)²¹—a national database of DNA profiles taken from crime scenes and persons convicted of qualifying crimes.²²

16. See discussion *infra* Part III.

17. Malcom, *supra* note 10, at 317. DNA is present in the cell nucleus, or in the mitochondria, and consists of two strands of polymers “shaped like a twisted ladder” (commonly known as the “double-helix”). *Id.* The polymers are composed of “repeating sequences of phosphate and sugar molecules.” *Id.* Each DNA strand is composed of chemical components arranged in sequences known as genes; the specific sequences of the chemical components vary among individuals. *Id.*; MICHAELIS ET AL., *supra* note 6, at 11. For a more extensive explanation of “the structure of DNA and the variability of the human DNA sequence,” see MICHAELIS ET AL., *supra* note 6, at 1–14.

18. Kimberly A. Polanco, *The Fourth Amendment Challenge to DNA Sampling of Arrestees Pursuant to the Justice for All Act of 2004: A Proposed Modification to the Traditional Fourth Amendment Test of Reasonableness*, 27 U. ARK. LITTLE ROCK L. REV. 483, 483 (2005).

19. Malcom, *supra* note 10, at 313 (“DNA evidence has been heralded as a powerful tool for both conviction and exoneration . . . [s]ince the onset of DNA typing in the mid-1980s.”).

20. DNA Identification Act of 1994, (codified at 42 U.S.C. § 14132 (2006)), is part of the Violent Crime Control and Law Enforcement Act of 1994, Pub. L. No. 103-322, 108 Stat. 1796 (codified at 42 U.S.C. § 13701 (2006)).

21. Peterson & Leggett, *supra* note 4, at 636; Polanco, *supra* note 18, at 483. Although the DNA Identification Act of 1994 authorized creation of the national index in 1994, CODIS was not online and ready for use until 1998. Peterson & Leggett, *supra* note 4, at 636. The Act also provided funding for all states to establish their own DNA laboratories and testing procedures. *Id.*

22. See Peterson & Leggett, *supra* note 4, at 636; Polanco, *supra* note 18, at 483. All fifty states contribute DNA profiles to CODIS. Polanco, *supra* note 18, at 483; see also MICHAELIS ET AL., *supra* note 6, at 100 (“The DNA Analysis Backlog Elimination Act of 2000 authorized the collection of DNA sample from prisoners, parolees and others on supervised release after committing one of a list of qualifying crimes.”). These crimes include: murder, voluntary manslaughter, maiming, sexual abuse, sexual exploitation, slavery, kidnapping, incest, arson, robbery, and burglary. DNA Analysis Backlog Elimination Act of 2000, Pub. L. No. 106-546, 114 Stat. 2726 (codified at 42 U.S.C. 14135a(d) (2006)). Additionally, “[t]he USA Patriot Act of 2001 added terrorist acts to the list of eligible crimes, and the Justice for All Act of 2004 further expanded the list of eligible crimes to all felonies.” MICHAELIS ET

DNA is “now used as a tool [by law enforcement] for suspect identification.”²³ DNA evidence collected from crime scenes is compared to profiles stored in CODIS and state DNA databases.²⁴ This allows law enforcement officials to determine if there is a match with evidence collected from a previous crime scene or with a person previously convicted of a crime.²⁵

B. The Israeli Research Study

1. Background and Findings

The scientists employed by Nucleix, Ltd. successfully synthesized artificial DNA using three methods: polymerase chain reaction (PCR), whole genome amplification (WGA), and profile assemblage using the CODIS allele library.²⁶ PCR essentially works like a photocopier, enabling the analyst to make millions of copies of a specified portion of the DNA molecule.²⁷ For the PCR portion of the study, the researchers obtained human DNA from a cigarette butt to “copy.”²⁸

The second technique employed by the Nucleix researchers—WGA—is a standard technique similar to PCR except that WGA involves the amplification of the full genome sequence rather than a small portion.²⁹ The researchers used human DNA from a saliva stain on a piece of paper as a template for the WGA process.³⁰ The

AL., *supra* note 6, at 100; *see also* Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism (USA PATRIOT ACT) Act of 2001, Pub. L. No. 107-56, § 503, 115 Stat. 272, 274 (codified as 18 U.S.C. § 1 (2006)); Justice for All Act of 2004, Pub. L. No. 108-405, § 203, 118 Stat. 2260, 2270 (codified as amended at 42 U.S.C. § 14135a(d) (2006)).

23. Polanco, *supra* note 18, at 483.

24. *Id.*

25. *Id.*

26. Frumkin et al., *supra* note 1, at 2.

27. MICHAELIS ET AL., *supra* note 6, at 32. PCR is the leading DNA testing procedure and is generally accepted by the legal community. Malcom, *supra* note 10, at 318.

28. Frumkin et al., *supra* note 1, at 2, 4.

29. *See* Jay Shendure et al., *Advanced Sequencing Technologies: Methods and Goals*, 5 NAT. REV. GENET. 335, 341 (May 2004), available at http://www.nature.com/nrg/journal/v5/n5/glossary/nrg1325_glossary.html.

30. Frumkin et al., *supra* note 1, at 4.

researchers also generated artificial blood samples to be planted at the crime scenes.³¹

Last, the researchers used a profile from the CODIS-allele library and created a completely new sample of a DNA sequence using molecular cloning.³² No physical sample of a particular DNA sequence was needed; the researchers were able to assemble a profile of both an existing and non-existing person.³³ Both the Nucleix laboratory and an independent laboratory analyzed the samples after they were processed using normal forensic procedures.³⁴

Following the creation of the artificial DNA samples, the researchers found that “artificial DNA can easily be applied to surfaces of objects or incorporated into genuine human tissues.”³⁵ Furthermore, the researchers, as well as an independent laboratory used by United States law enforcement agencies, were unable to distinguish between artificial and genuine DNA samples.³⁶

31. *Id.* The researchers took a genuine whole blood sample from a woman, and through centrifugation, removed the DNA containing white blood cells. Andrew Pollack, *DNA Evidence Can Be Fabricated*, *Scientists Show*, N.Y. TIMES, Aug. 18, 2009, at D3. The researchers then mixed the remaining red blood cells from the blood sample with the artificially synthesized DNA. *Id.*

32. Frumkin et al., *supra* note 1, at 4. Molecular cloning refers to the copying of DNA fragments and their insertion into a different cell or organism. Bart Hansen, *Embryonic Stem Cell Research: Terminological Ambiguity May Lead to Legal Obscurity*, 23 MED. & L. 19, 20 (2004); Government of Canada BioPortal, BioBasics Glossary, <http://www.biobasics.gc.ca/english/View.asp?x=696&mid=422> (last visited Sept. 28, 2010).

33. Frumkin et al., *supra* note 1, at 4. For the creation of the DNA profile of an existing individual, the researchers simply molecularly cloned an existing profile in CODIS. *Id.* In order to create a profile of a non-existing person, the researchers created a profile identical to that of an existing individual with the exception of the position of a particular gene, which the researchers altered. *Id.* The researchers calculated “the probability that there does not exist in the world population” an unrelated person with an identical profile as greater than 99.99%. *Id.*

34. *Id.*

35. *Id.* The researchers applied DNA samples to a handgun and a ski mask and incorporated artificial DNA into blood which was planted as bloodstains. *Id.* All of these samples were analyzed along with genuine DNA evidence for a basis of comparison. *Id.* The artificial DNA created by the researchers consisted of DNA fragments, which are copies of a portion of a DNA molecule. *See id.*; MICHAELIS ET AL., *supra* note 6, at 32. This is distinguishable from the DNA that makes up the human genome, the collection of genes that make individuals unique, which is made up of “vast stretches of DNA.” MICHAELIS ET AL., *supra* note 6, at 414; National Human Genome Research Institute, DNA Sequencing Fact Sheet, <http://www.genome.gov/10001177> (last visited Sept. 28, 2010).

36. Frumkin et al., *supra* note 1, at 6–7. In addition to analyzing the samples themselves, the researchers sent duplicate samples to a “leading forensic DNA laboratory for analysis.” *Id.* at 4. “The procedures employed by this [independent] laboratory have been validated according to standards established by the Scientific Working Group on DNA Analysis Methods (SWGDM) and adopted as US Federal Standards.” *Id.*

2. *Implications and Proposal*

The ease with which artificial DNA can be fabricated and planted at a crime scene raised several concerns for the researchers.³⁷ First, one can create a DNA profile that matches a profile in CODIS, which will create a false positive—leading law enforcement officials to believe they have a “match” when they do not.³⁸ A profile and sample of a non-existing person can also be created artificially and planted, which will not result in a match but may lead investigators in the wrong direction.³⁹ Finally, DNA evidence is heavily relied on in courtrooms, so this discovery creates issues regarding the credibility and authenticity of DNA evidence.⁴⁰

Although the current forensic procedures used by United States’ forensic analysts are unable to recognize artificial DNA, the Nucleix researchers claim they have developed a method that allows them to distinguish artificial DNA from genuine DNA.⁴¹ Genuine DNA goes through several modifications each time it replicates—one of these modifications is known as methylation.⁴² Thus, genuine DNA contains methylated components.⁴³ Synthesized DNA, on the other hand, is solely unmethylated.⁴⁴ With this difference in mind, the researchers were able to develop a technique that analyzes the methylation pattern of DNA samples, revealing whether the sample is artificial or genuine.⁴⁵ The authentication technique is both time

37. *Id.* at 7.

38. *Id.* at 7–8.

39. *Id.* at 8.

40. Frumkin et al., *supra* note 1, at 8.

41. *Id.* at 4.

42. Premier Biosoft International, DNA Methylation, http://www.premierbiosoft.com/molecular_beacons/dna-methylation/ (last visited Sept. 28, 2010).

43. A methylated DNA component is one that has received a methyl group (CH₃); components that are unmethylated have not received a methyl group. *See* MOSBY’S MEDICAL DICTIONARY 1184 (8th ed. 2009), available at <http://medicaldictionary.thefreedictionary.com/Methylated>.

44. Frumkin et al., *supra* note 1, at 4.

45. *Id.* at 4–5. In addition to this methylation technique, the Nucleix researchers also briefly discussed several alternative methods of DNA authentication including techniques that are “based on analysis of stutter products, representation bias, distribution of DNA fragment sizes, and presence of non-genomic sequences.” *Id.* at 8.

consuming and labor intensive, but it is necessary to ensure only genuine samples are introduced into evidence.⁴⁶

C. *Ease of Creating Artificial DNA*

1. *Who and How?*

When conducting their study, the Nucleix researchers used common everyday objects, including a cigarette butt, in order to obtain DNA.⁴⁷ Even without a physical DNA sample, researchers can produce artificial DNA evidence using a profile from a DNA database.⁴⁸ Once the DNA sample or profile has been obtained, the actual fabrication is relatively simple with large amounts of genetic material produced overnight “using basic laboratory equipment and commercial kits.”⁴⁹ In the growing field of scientific research, a great number of people possess the knowledge and equipment to fabricate DNA.⁵⁰

2. *Availability of DNA Samples and Profiles*

When DNA is collected during a criminal investigation, the majority of states retain these DNA samples even after the investigation and case have closed.⁵¹ While crime labs retain samples

46. See *id.* at 8. The researchers suggest this DNA authentication method, or those discussed *supra* note 45, be implemented into current forensic procedures. Frumkin et al., *supra* note 1, at 1.

47. *Id.* at 7. The researchers also used “[s]amples of blood, dry saliva stains on absorbent paper, skin scrapings, [and] hair” in their study. *Id.* at 2.

48. *Id.* at 7.

49. *Id.* The researchers assert that DNA samples of “any desired genetic profile” can be easily fabricated and planted by practically anyone, using common biological techniques. See *id.* at 1.

50. *Id.* at 7. “[S]cientists, research students, lab technicians in hospitals, pharmaceutical or biotech companies, etc.” are examples of individuals and organizations having both the resources and knowledge to fabricate DNA. *Id.* at 7. Furthermore, in order to be considered a forensic scientist, a person only needs a Bachelor of Science degree in biology or chemistry. Craig M. Cooley, *Reforming the Forensic Science Community to Avert the Ultimate Injustice*, 15 STAN. L. & POL’Y REV. 381, 388 (2004). However, even this is not necessary in order to be able to fabricate DNA. See *infra* text accompanying note 54 and *supra* text accompanying note 2.

51. Aaron P. Stevens, *Arresting Crime: Expanding the Scope of DNA Databases in America*, 79 TEX. L. REV. 921, 935 (2001). The reasons provided by crime labs for saving samples include possible uses “for reanalysis at a later date when technology improves; for the defense counsel of an individual identified through a database search; and for facilitating routine quality control tests.” *Id.*

to allow for possible additional future testing and to facilitate quality control tests, saving samples provides easy access to DNA samples to replicate or plant.⁵² Even if the actual physical DNA sample is unavailable, the expanding DNA databases and databanks⁵³ also provide opportunity for DNA fabrication. Additionally, DNA sequences can now be ordered online, so creating artificial DNA “does not require much more than a personal computer and link to the internet.”⁵⁴

The DNA Identification Act of 1994 authorized the provision of grant money for states to establish DNA databanks.⁵⁵ Three types of databanks exist in the United States and contain profiles from people convicted of certain crimes, profiles from evidence samples collected, and profiles from DNA samples “voluntarily contributed by relatives of missing persons.”⁵⁶ States have different criteria for including DNA in each of the databanks⁵⁷ and different degrees of security to protect unauthorized use thereof.⁵⁸ Some states allow public officials to access DNA databank information “for purposes other than law enforcement.”⁵⁹

The DNA Analysis Backlog Elimination Act of 2000 has dramatically expanded the number of samples and qualifying

52. *See id.*

53. Although many refer to databases and databanks interchangeably or refer to both simply as databases, there is actually a distinction between the two. MICHAELIS ET AL., *supra* note 6, at 99 (“Databanks are used to investigate crimes and identify suspects, whereas databases are used to provide estimates of how rare a particular DNA profile is in the larger population.”).

54. Frumkin et al., *supra* note 1, at 7.

55. MICHAELIS ET AL., *supra* note 6, at 99.

56. *Id.* Every state maintains the two types of databanks that contain the profiles of convicted offenders of the qualifying crimes and profiles collected from crime scene evidence. *Id.* Only some states have the third type of databank containing profiles of missing persons contributed by relatives. *Id.* These databanks contain “extensive personal information on the individuals corresponding to the profiles . . . and are designed to allow law enforcement officers to locate the individual if there is a match between an evidence sample and an entry in a databank.” *Id.*

57. *Id.* at 100.

58. *Id.*

59. MICHAELIS ET AL., *supra* note 6, at 100. Some states have stricter regulations in which unauthorized release of DNA databank information is a criminal act. *Id.* Others only allow persons whose profiles are contained within the databank to access the information for purposes related to their trial. *Id.* In other states, databanks may only be accessed by law enforcement agencies. *Id.*

individuals for databank contribution.⁶⁰ The CODIS database has continued to grow as well—now containing over three million profiles.⁶¹ Many states have also expanded the list of eligible crimes allowing for the collection of DNA samples.⁶² Some have suggested the more extreme step of having DNA samples of all Americans included in the database by collecting DNA samples at birth.⁶³ Unfortunately, this would significantly increase the amount of already available samples and profiles available for DNA fabrication.

3. History of Forensic Tampering and Fraud Within the Criminal Justice System

The American criminal justice system is no stranger to forensic falsification. Many forensic scientists and law enforcement officials have intentionally falsified results.⁶⁴ Perhaps the most notable occurrence was that of Fred Zain, a West Virginia forensic scientist who falsified laboratory reports⁶⁵ and “gave perjured testimony for

60. See 42 U.S.C. § 14135 (2006). The Act “authorized the collection of DNA samples from prisoners, parolees and others on supervised release after committing one of a list of qualifying crimes.” MICHAELIS ET AL., *supra* note 6, at 100; see also 42 U.S.C. § 14135(a); see *supra* note 22 for a list of the qualifying crimes under the Act.

61. Peterson & Leggett, *supra* note 4, at 653.

62. MICHAELIS ET AL., *supra* note 6, at 100. Due to “[s]tudies showing a high recidivism rate for individuals who commit nonviolent crimes and then progress to commit violent crimes,” some state legislatures have been persuaded to extend the qualifying crimes to include nonviolent ones. Peterson & Leggett, *supra* note 6, at 636; see also MICHAELIS ET AL., *supra* note 6, at 100. Virginia is one such state, and “more than half the databank ‘hits’ that have helped solve violent crimes . . . have come from profiles of individuals who had previously been convicted of nonviolent crimes.” MICHAELIS ET AL., *supra* note 6, at 100 (emphasis omitted). Additionally, while the CODIS database only contains profiles of individuals convicted of qualifying crimes, many states now collect DNA from individuals merely arrested for certain crimes. Polanco, *supra* note 18, at 484–85; see also Stevens, *supra* note 51, at 948 (stating that three states “require DNA samples from individuals who are merely arrested for sexual felonies”); Frumkin et al., *supra* note 1, at 7 (“The DNA profiles of millions of people are registered in rapidly growing national databases, and the current trend around the world is to include more and more profiles in them, not only of convicted offenders, but also of arrestees.”).

63. MICHAELIS ET AL., *supra* note 6, at 100. Former New York City mayor Rudi Giuliani is among the individuals who have advocated “taking DNA samples from all babies born in American hospitals.” *Id.*

64. Malcom, *supra* note 10, at 320.

65. *Id.*

years to fit the needs of criminal investigators and prosecutors.”⁶⁶ Zain was found to have manipulated test results in 134 cases.⁶⁷

Another set of incidents occurred within the Illinois State Police crime laboratory when analyst Pamela Fish lied about results of tests she performed and knowingly failed to disclose exculpatory forensic evidence.⁶⁸ Her actions resulted in the conviction of several innocent persons; these convictions were subsequently overturned.⁶⁹ Similarly, Texas forensic pathologist Ralph Erdmann was convicted of falsifying autopsies, but not before his testimony aided in at least twenty death penalty convictions.⁷⁰ Erdmann is known for making “findings and testimony that harmonize with police theories” and “making most of his cases for prosecutors.”⁷¹

In addition to individual incidents of falsification, entire institutions have been suspected of misconduct.⁷² The Houston Police Department closed its DNA laboratory following a criminal investigation showing erroneous results,⁷³ causing over 1,000 cases to

66. Peterson & Leggett, *supra* note 4, at 650. Zain’s manipulation of evidence and false reporting occurred over a ten year period. Malcom, *supra* note 10, at 320.

67. Malcom, *supra* note 10, at 320. Zain’s acts of misconduct included the following:

(1) overstating the strength of results; (2) overstating the frequency of genetic matches on individual pieces of evidence; (3) misreporting the frequency of genetic matches on multiple pieces of evidence; (4) reporting that multiple items had been tested, when only a single item had been tested; (5) reporting inconclusive results as conclusive; (6) repeatedly altering laboratory records; (7) grouping results to create the erroneous impression that genetic markers had been obtained from all samples tested; (8) failing to report conflicting results; (9) failing to conduct or to report conducting additional testing to resolve conflicting results; (10) implying a match with a suspect when testing supported only a match with the victim; and (11) reporting scientifically impossible or improbable results.

Cooley, *supra* note 50, at 405–06.

68. Malcom, *supra* note 10, at 320. In one case, “Fish testified her lab results were inconclusive, though later investigation revealed a ‘single sheet of paper’ showing that Fish did not find [the defendant’s] blood type in semen recovered from the crime scene of a rape.” *Id.*

69. *Id.* Fish’s testimony of the DNA analysis she conducted in one case assisted in the conviction of four teenagers for rape and murder. *Id.* Post-conviction DNA testing cleared all four of the individuals, and the convictions were overturned. *Id.*

70. Cooley, *supra* note 50, at 401.

71. Richard L. Fricker, *Grave Mistakes*, 79 A.B.A. J., Dec. 1993, at 46, 46 (stating that investigators “discovered that [Erdmann] either charged the counties for autopsies but didn’t do the work, botched the work completely, or falsified the results to fit the prosecution’s case”).

72. Malcom, *supra* note 10, at 320.

73. *Id.* at 320–21 (“[I]nvestigations revealed egregious problems with the lab’s protocol . . . and [r]etesting in dozens of cases . . . confirmed that the Houston lab’s results were erroneous.”). The investigation found the following:

be reviewed.⁷⁴ The investigation revealed wrongdoing by nine of the crime lab employees.⁷⁵

Criminals have also tampered with DNA evidence.⁷⁶ Correctional officers in Utah overheard “prisoners coaching each other on how to spread blood and semen samples from other people around crime scenes to try to fool DNA analysts.”⁷⁷ In Wisconsin, a criminal convicted of rape smuggled his semen out of jail in ketchup packets and paid a woman to plant it in a staged rape to convince law enforcement officials that the “real rapist” was still on the loose.⁷⁸ If the Nucleix research proves valid, future criminals need only pay someone to fabricate the DNA.

D. Current DNA Admissibility Standards

The standards for DNA admissibility vary among courts. Most courts have been open to DNA evidence and typically admit DNA evidence.⁷⁹ Some courts have even “declare[ed] that the general reliability of DNA typing is judicially noticeable.”⁸⁰ Additionally,

(1) the lab’s personnel lacked necessary training and experience; (2) the lab’s facility failed to minimize the possibility of loss or damage of evidence; (3) the lab did not employ proper checks and balances to confirm the quality of examiners’ methods and procedures; and (4) the lab was not designed to provide adequate security and minimize contamination.

Cooley, *supra* note 50, at 407.

74. *Id.* Of the more than 1,000 cases that are under review, 17 are death penalty cases. *Id.* The county that the lab serviced “has sent the most defendants to death row in the United States.” *Id.* At least one wrongful DNA conviction has now been attributed to the lab. *Id.*

75. *Id.*

76. Polanco, *supra* note 18, at 528 (stating that criminals have manipulated DNA evidence to “mask their identit[ies],” and they “are taking unusual steps to ensure that they leave no biological evidence at the scene of a crime[—]or that they leave someone else’s”). Additionally, “rape victims in California, Michigan and New York have reported incidents in which their assailants forced them to clean and bathe to try to scrub away any DNA evidence.” Richard Willing, *Criminals Try to Outwit DNA*, USA TODAY, Aug. 28, 2000, at A1, available at 2000 WLNR 3508041.

77. Willing, *supra* note 76, at A1.

78. Polanco, *supra* note 18, at 528–29; Willing, *supra* note 76, at A1.

79. Edward J. Imwinkelried, *The Debate in the DNA Cases over the Foundation for the Admission of Scientific Evidence: The Importance of Human Error as a Cause of Forensic Misanalysis*, 69 WASH. U. L.Q. 19, 20 (1991) (“The overwhelming majority of courts that have passed on DNA typing have held the evidence admissible.”).

80. *Id.* at 20–21. In *State v. Woodall*, the West Virginia Supreme Court of Appeals noted that “the reliability of [DNA testing] is now generally accepted by geneticists, biochemists, and the like. Thus, no *Frye* hearing will be required in the future for judicial notice of reliability.” *State v. Woodall*, 385 S.E.2d 253, 260 (W. Va. 1989) (citation omitted); see also *United States v. Jakobetz*, 955 F.2d 786, 799 (2d Cir.

many courts have ruled that deficiencies in DNA typing analysis affect the weight given to the evidence, not its admissibility.⁸¹ Many jurisdictions, however, continue to follow admissibility standards set forth by case precedent and the Federal Rules of Evidence.⁸²

1. Frye Standard

Some jurisdictions⁸³ use the *Frye* Standard, as set forth in *Frye v. United States*⁸⁴—the first effort by courts to standardize the admissibility of scientific evidence.⁸⁵ In *Frye*, the court denied admissibility of the results of a systolic blood pressure deception test (lie detector test)⁸⁶ based on a “general acceptance” standard.⁸⁷ This standard established that in order for a new scientific principle or test to be admitted into evidence, it must “‘be sufficiently established to have gained general acceptance’ within the relevant scientific

1992) (“[A] court could properly take judicial notice of the general acceptability of the general theory and the use of [DNA profiling] techniques.”). Additionally, some jurisdictions have expressly declared DNA evidence as reliable through statutes, eliminating the need for a preliminary hearing to determine the reliability or scientific acceptance of the DNA technique used. Thomas M. Fleming, Annotation, *Admissibility of DNA Identification Evidence*, 84 A.L.R. 4th 313 § 3(b) (2009).

81. Imwinkelried, *supra* note 79, at 21.

82. See MICHAELIS ET AL., *supra* note 6, at 218–19 (asserting that Federal Rules of Evidence 104(a), 401, 402, and 702 govern admissibility of scientific and technical evidence in many courts).

83. Courts in Alabama, Arizona, California, Colorado, the District of Columbia, Florida, Illinois, Kansas, Maryland, Michigan, Minnesota, Mississippi, Nebraska, New Jersey, New York, Pennsylvania, and Washington continue to use the *Frye* Standard. David E. Bernstein, *Frye, Frye Again: The Past, Present, and Future of the General Acceptance Test*, 41 JURIMETRICS J. 385, 386–87 (2001).

84. *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923).

85. MICHAELIS ET AL., *supra* note 6, at 216. This standard was viewed as the “gold standard of admissibility for scientific evidence.” Joshua Hillel Hubner, *Blinded by Science: Does the General Acceptance of Forensic DNA Evidence Warrant a More Streamlined Approach to Admissibility?*, 18 U. FLA. J.L. & PUB. POL’Y 93, 93 (2007). All the states have built their standards based on it. MICHAELIS ET AL., *supra* note 6, at 216.

86. An expert for the defendant “asserted that blood pressure is influenced by change in the emotions of the witness, and that the systolic blood pressure rises are brought about by nervous impulses sent to the sympathetic branch of the autonomic nervous system.” *Frye*, 293 F. at 1013. He further asserted that tests have shown “that fear, rage, and pain always produce a rise of systolic blood pressure, and that conscious deception or falsehood, concealment of facts, or guilt of crime, accompanied by fear of detection when the person is under examination, raises the systolic blood pressure.” *Id.*

87. See Hubner, *supra* note 85, at 96–97 (stating that the *Frye* court held the systolic blood pressure deception test inadmissible because it “had not yet gained ‘general acceptance’ with physiologists and psychologists”); Pamela J. Jensen, Note, *Frye Versus Daubert: Practically the Same?*, 87 MINN. L. REV. 1579, 1581 (2003) (asserting that the *Frye* court required the principle or test sought to be admitted to have reached general acceptance within the pertinent scientific community).

community.”⁸⁸ The court found that this lie detector test failed under the standard because it had not yet been sufficiently recognized by scientists to justify allowing expert testimony based on the technique.⁸⁹

The *Frye* standard determines the admissibility of “new or novel scientific and technical evidence”⁹⁰ and has been extended to nearly all types of scientific principles and techniques.⁹¹ It is considered to be stricter than the *Daubert* standard.⁹² DNA evidence offered in *Frye* courts has been challenged by questioning the laboratory’s failure to follow “generally accepted scientific procedures.”⁹³ Admission of DNA statistical data is more difficult under *Frye*.⁹⁴

2. Frye-Kelly Hybrid Standard

The *Frye-Kelly* standard was set forth in the 1976 case of *People v. Kelly*,⁹⁵ in which the California Supreme Court adopted a modified *Frye* standard.⁹⁶ In *Kelly*, the court was faced with the task of deciding the admissibility of “voice print” identification evidence.⁹⁷ Under the new standard, for a new scientific principle or technique to be admitted into evidence, it must pass a three part test.⁹⁸ First, the

88. Jensen, *supra* note 87, at 1581 (quoting *Frye*, 293 F. at 1014). “In most cases, the presence of a body of literature published in peer-reviewed journals constitutes strong support for the argument that the technique or principle involved has gained general acceptance.” MICHAELIS ET AL., *supra* note 6, at 217.

89. *Frye*, 293 F. at 1014 (“We think the systolic blood pressure deception test has not yet gained such standing and scientific recognition among physiological and psychological authorities as would justify the courts in admitting expert testimony deduced from the discovery, development, and experiments thus far made.”). See Craig I. Omura, Comment, *Kelly/Frye Analysis: DNA Evidence on Trial*, 18 W. ST. U. L. REV. 331, 332 (1990).

90. Hubner, *supra* note 85, at 97.

91. Jensen, *supra* note 87, at 1582.

92. Jennifer Callahan, *The Admissibility of DNA Evidence in the United States and England*, 19 SUFFOLK TRANSNAT’L L. REV. 537, 547–48 (1996).

93. *Id.* at 546–47 (citing *People v. Castro*, 545 N.Y.S.2d 985, 996 (Sup. Ct. 1989)) (finding that because the DNA profiling testing failed to follow generally accepted scientific procedures by not using controls in the testing, the DNA testing results were inadmissible).

94. See R. Stephen Kramer, Comment, *Admissibility of DNA Statistical Data: A Proliferation of Misconception*, 30 CAL. W. L. REV. 145, 165 (1993).

95. *People v. Kelly*, 549 P.2d 1240 (Cal. 1976).

96. Omura, *supra* note 89, at 333.

97. *Id.* Voice print evidence refers to the “technique of speaker identification by spectrographic analysis.” *Kelly*, 549 P.2d at 1242.

98. Omura, *supra* note 89, at 333.

proponent of the evidence must establish that the underlying theory is reliable.⁹⁹ Second, the witness testifying “must be properly qualified as an expert to give an opinion on the subject.”¹⁰⁰ Lastly, the proponent must show that the correct scientific procedures were used and that they are generally accepted in the scientific community.¹⁰¹

3. *Daubert Standard*

In 1993, the Supreme Court, in providing its own test for DNA admissibility known as the *Daubert* standard, held that the Federal Rules of Evidence supersede the *Frye* Standard.¹⁰² In *Daubert*, the petitioners offered testimony by experts relying on recalculations of previously published epidemiological studies to show that a drug produced by the pharmaceutical company caused birth defects.¹⁰³ The Court announced that Federal Rule of Evidence 702 would supersede the *Frye* standard.¹⁰⁴ The Court also enumerated several guidelines for determining the admissibility of scientific theories or techniques.¹⁰⁵ When evaluating admissibility, a court should look at

99. See MICHAELIS ET AL., *supra* note 6, at 216; Omura, *supra* note 89, at 333. This is usually established through expert testimony showing its general acceptance in the relevant scientific community. Omura, *supra* note 89, at 333.

100. Omura, *supra* note 89, at 333 (emphasis omitted).

101. MICHAELIS ET AL., *supra* note 6, at 216; Omura, *supra* note 89, at 333. The California Supreme Court has interpreted the third prong of this test as requiring the procedure or test being used to be “correct” and not the methods applying the procedure to be correct. Kramer, *supra* note 94, at 168. Therefore, any deficiencies in the testing procedures affect the weight given to the evidence rather than its admissibility. *Id.* Despite the California Supreme Court’s guidance, disagreement and confusion remains, especially in the California Court of Appeals, on what the third prong truly requires. *Id.* at 168–69.

102. *Daubert v. Merrill Dow Pharm., Inc.*, 509 U.S. 579, 597–98 (1993).

103. Hubner, *supra* note 85, at 97.

104. *Id.*; see also Callahan, *supra* note 92, at 545–46 (stating that the *Daubert* holding required that the Federal Rules of Evidence be applied “when determining the admissibility of expert testimony” regarding scientific evidence); Jensen, *supra* note 87, at 1582 (“[T]he Supreme Court held that the *Frye* standard was superseded by Federal Rule of Evidence 702, which governs expert testimony.”). Because “the District Court and the Court of Appeals focused almost exclusively on ‘general acceptance,’” the Court vacated the judgment and remanded the case for further proceedings consistent with the Federal Rules of Evidence and guidelines set forth by the Court. *Daubert*, 509 U.S. at 597–98. Although on remand the evidence was dismissed, the *Daubert* standard is still considered more liberal than the *Frye* standard. *Daubert v. Merrill Dow Pharm., Inc.*, 43 F.3d 1311, 1322 (9th Cir. 1995), cert. denied, 516 U.S. 869 (1995); see Peterson & Leggett, *supra* note 4, at 640.

105. Callahan, *supra* note 92, at 546; Jensen, *supra* note 87, at 1583; see also Hubner, *supra* note 85, at 97.

whether the theory or technique has been tested and subjected to peer review and publication, what the “known or potential rate of error” is, and whether the theory or technique is generally accepted within its field.¹⁰⁶

The Court believed the *Frye* standard was too strict and decided on a new standard that would be more consistent with the Federal Rules of Evidence.¹⁰⁷ Under *Daubert*, courts determine the evidentiary reliability of scientific evidence based on scientific validity.¹⁰⁸ Contrary to *Frye*, the *Daubert* standard allows courts to admit evidence even if it is not generally accepted by the relevant community.¹⁰⁹ The *Daubert* standard also allows courts to exclude expert evidence that violates Federal Evidence Rule 403.¹¹⁰ Following *Daubert*, federal courts must apply Rule 702¹¹¹ when determining the admissibility of DNA evidence.¹¹² Despite the Court’s decision in *Daubert*, many state courts continue to use differing standards of evidence.¹¹³

106. Hubner, *supra* note 85 at 97–98 (quoting *Daubert*, 509 U.S. at 593–94); Jensen, *supra* note 87, at 1583 (quoting *Daubert*, 509 U.S. at 593–94).

107. See Jensen, *supra* note 87, at 1582.

108. *Id.* (quoting *Daubert*, 509 U.S. at 590 n.9). Courts should decide as a preliminary matter “whether the reasoning or methodology underlying the testimony is scientifically valid and . . . whether that reasoning or methodology properly can be applied to the facts in issue.” *Daubert*, 509 U.S. at 592–93; see also Callahan, *supra* note 92, at 545–46 (“[*Daubert*] requires that federal judges conduct a preliminary hearing to determine the relevance and reliability of expert testimony.”).

109. Callahan, *supra* note 92, at 545.

110. FED. R. EVID. 403 (“Although relevant, evidence may be excluded if its probative value is substantially outweighed by the danger of unfair prejudice, confusion of the issues, or misleading the jury, or by considerations of undue delay, waste of time, or needless presentation of cumulative evidence.”); Callahan, *supra* note 92, at 546.

111. FED. R. EVID. 702 (“If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise, if (1) the testimony is based upon sufficient facts or data, (2) the testimony is the product of reliable principles and methods, and (3) the witness has applied the principles and methods reliably to the facts of the case.”).

112. Callahan, *supra* note 92, at 548.

113. See MICHAELIS ET AL., *supra* note 6, at 221 (“[S]tates are not bound to follow Supreme Court rulings on evidentiary methods.”).

4. *Federal Rules of Evidence*

The Federal Rules of Evidence were established to “create a uniform standard of admissibility of evidence.”¹¹⁴ For cases involving scientific evidence, the federal rules have greatly expanded the trial judge’s “gate-keeping” role.¹¹⁵ Rule 104(a) adds to this role by providing the trial judge with the authority not only to determine the admissibility of evidence but also to address preliminary issues concerning the qualifications of proposed witnesses.¹¹⁶ Rule 402 sets forth the requirement that evidence be relevant in order to be admitted.¹¹⁷ Rules 403 and 702 in particular have affected admissibility of DNA—providing much greater judicial discretion.¹¹⁸

Federal Rule 702 allows the trial judge to decide whether testimony is necessary to understand the evidence or to resolve an issue of fact.¹¹⁹ Rule 403 allows the judge to exclude relevant evidence if he or she finds that the probative value of the evidence substantially outweighs its prejudicial effect.¹²⁰ Following the *Daubert* decision, all federal courts use the Federal Rules of Evidence in determining admissibility of scientific theories and techniques.¹²¹

E. *The Need for Reevaluation*

The incidents of falsification of forensic evidence, the availability of DNA samples and profiles, and the ease of DNA fabrication

114. *Id.* at 218.

115. *Id.*

116. FED. R. EVID. 104(a) (“Preliminary questions concerning the qualification of a person to be a witness, the existence of a privilege, or the admissibility of evidence shall be determined by the court.”); *see also* MICHAELIS ET AL., *supra* note 6, at 218; Jensen, *supra* note 87, at 1583.

117. FED. R. EVID. 402 (“All relevant evidence is admissible, except as otherwise provided by the Constitution of the United States, by Act of Congress, by these rules, or by other rules prescribed by the Supreme Court pursuant to statutory authority. Evidence which is not relevant is not admissible.”); MICHAELIS ET AL., *supra* note 6, at 218. Rule 401 defines “relevant evidence” as “evidence having any tendency to make the existence of any fact that is of consequence to the determination of the action more probable or less probable than it would be without the evidence.” FED. R. EVID. 401.

118. MICHAELIS ET AL., *supra* note 6, at 218.

119. FED. R. EVID. 702.

120. FED. R. EVID. 403; MICHAELIS ET AL., *supra* note 6, at 218; Callahan, *supra* note 92, at 546.

121. *See* Callahan, *supra* note 92, at 545–46; Hubner, *supra* note 85, at 97; Jensen, *supra* note 87, at 1582.

underscores the need to reevaluate the way we look at DNA admissibility and reliability. As a result of the many forensic-related television shows,¹²² many Americans have a distorted view of the reliability of forensic evidence.¹²³ This phenomenon, coined the “CSI effect,” has resulted in misperceptions among a large segment of the American public regarding the reliability of forensic labs as well as the scientists they employ.¹²⁴ The possibility of DNA fabrication makes this issue more problematic and demonstrates the need for reevaluating the credibility and admissibility of DNA evidence.

II. ANALYSIS

A. DNA Evidence Under the Current Admissibility Standards

1. DNA Evidence Under the *Frye* Standard

Many courts following the *Frye* standard have “deemed the underlying theory of DNA testing generally acceptable,”¹²⁵ as well as DNA profiling itself.¹²⁶ However, there is not universal acceptance

122. These forensic science television series include “*CSI*, *CSI: Miami*, *CSI: New York*, and *Crossing Jordan*.” Craig M. Cooley, *The CSI Effect: Its Impact and Potential Concerns*, 41 NEW ENG. L. REV. 471 (2007).

123. Cooley, *supra* note 122, at 471.

124. *Id.* Three of these general misperceptions are: (1) crime labs are “pristine scientific sanctuaries” with the most current forensic technology; (2) crime labs only employ skilled scientists who make little or no errors; and (3) “forensic scientists are [always] practicing and engaging in legitimate science.” *Id.* Additionally, because of these high expectations regarding DNA evidence, “jurors expect prosecutors to produce forensic DNA evidence in every case, and tend to judge the prosecution more harshly when the proof disappoints these expectations.” Neil Feigenson, *Brain-imaging and Courtroom Evidence: On the Admissibility and Persuasiveness of fMRI*, 2 INT’L J.L. CONTEXT 233, 250 (2006).

125. Lisa Carrabino, *The Admissibility of DNA Typing and Statistical Probability Evidence*, 29 SUFFOLK U. L. REV. 473, 495 n.156 (1995) (citing *State v. Moore*, 885 P.2d 457, 468 (Mont. 1994), *overruled on other grounds by State v. Gollehon*, 906 P.2d 697 (Mont. 1995); *People v. Castro*, 545 N.Y.S.2d 985, 999 (Sup. Ct. 1989); *State v. Cauthron*, 846 P.2d 502, 510 (Wash. 1993) (en banc)).

126. Veronica Valdivieso, *DNA Warrants: A Panacea for Old, Cold Rape Cases?*, 90 GEO. L.J. 1009, 1021 n.98 (2002) (referencing *Snowden v. State*, 574 So. 2d 960, 966 (Ala. Crim. App. 1990); *Smith v. Deppish*, 807 P.2d 144, 159 (Kan. 1991); *State v. Schwartz*, 447 N.W.2d 422, 426 (Minn. 1989); *Mandujano v. State*, 799 S.W.2d 318, 321–22 (Tex. Ct. App. 1990)).

by all *Frye* courts, and some continue to struggle with the admissibility of DNA evidence.¹²⁷

There are two methods which are commonly used to analyze DNA evidence:¹²⁸ restriction fragment length polymorphism (RFLP)¹²⁹ and PCR.¹³⁰ The PCR testing procedure is “generally accepted by the scientific community”¹³¹ and therefore has met the *Frye* standard of many state courts.¹³² In Florida, PCR testing has become so accepted that it does not have to undergo a preliminary *Frye* hearing to determine its admissibility.¹³³ RFLP has also gained acceptance in *Frye* jurisdictions.¹³⁴

While the testing procedures have been accepted by virtually all of the *Frye* courts,¹³⁵ DNA testing results have been met with mixed acceptance.¹³⁶ Some courts have admitted only DNA match evidence,¹³⁷ others admit only DNA statistical evidence,¹³⁸ and some admit both¹³⁹ or neither of the two.¹⁴⁰ DNA match evidence is

127. See Michael A. Riley, *How Should North Dakota Approach the Admissibility of DNA: A Comprehensive Analysis of How Other Courts Approach the Admissibility of DNA*, 72 N.D. L. REV. 607, 617–20 (1996).

128. Fleming, *supra* note 80, § 4.

129. The RFLP technique “compares short pieces of DNA from [a] sample with that from [an] individual.” *Id.*

130. See *supra* note 27 and accompanying text.

131. Fleming, *supra* note 80, § 2(d).

132. Carrabino, *supra* note 125, at 495 n.156 (citing *State v. Hill*, 895 P.2d 1238, 1247 (Kan. 1995); *State v. Williams*, 599 A.2d 960, 968 (N.J. Super. Ct. Law Div.1991); *State v. Gentry*, 888 P.2d 1105, 1118–19 (Wash. 1995) (en banc)).

133. Fleming, *supra* note 80, § 2(d) (citing *Zack v. State*, 911 So. 2d 1190 (Fla. 2005)).

134. Carrabino, *supra* note 125, at 494–95 n.156 (citing *Fishback v. People*, 851 P.2d 884, 893 (Colo. 1993) (en banc); *State v. Vandebogart*, 616 A.2d 483, 492 (N.H. 1992); *People v. Wesley*, 633 N.E.2d 451, 455 (N.Y. 1994)) (“RFLP has gained general acceptance under the *Frye* test in numerous state courts.”).

135. See *id.*

136. Riley, *supra* note 127, at 617.

137. *Id.* (citing *State v. Bible*, 858 P.2d 1152, 1193 (Ariz. 1993) (concluding random match probability calculations are not admissible because they are not accepted in the scientific community)). “Match evidence refers to the fact that the alleles of the suspect are similar to the alleles found in the samples collected at the crime screen.” *Id.*

138. *Id.* DNA statistical evidence refers to the calculation of the probability that the person in question is the source of the DNA sample. See Fleming, *supra* note 80, § 5.5. Statistical DNA evidence “depends on the frequency with which the genetic profile appears in the population of possible perpetrators, i.e., the rarity of the perpetrator’s profile in the population.” *Id.*

139. Riley, *supra* note 127, at 617 (citing *State v. Bloom*, 516 N.W.2d 159, 167 (Minn. 1994) (concluding that match evidence as well as statistical evidence is admissible)).

140. *Id.*

admissible in the majority of *Frye* jurisdictions.¹⁴¹ Debate continues in some *Frye* courts regarding the acceptance of population frequency evidence, though most have been moving toward acceptance.¹⁴² Other *Frye* courts will not admit match evidence unless it is coupled with admissible statistical evidence.¹⁴³ Despite this, there is a trend in *Frye* courts to admit both DNA statistical and match evidence.¹⁴⁴

2. *DNA Evidence Under the Frye-Kelly Standard*

Like the *Frye* test, the *Frye-Kelly* test looks to the general scientific reliability of DNA evidence.¹⁴⁵ However, under *Frye-Kelly*, the proponent of the evidence must also show that the correct scientific procedures were used to apply the theory.¹⁴⁶ Both the PCR and RFLP testing methods for DNA evidence have been admitted under the *Frye-Kelly* test due to their general acceptance in the scientific community.¹⁴⁷ Statistical DNA evidence has previously failed under the *Frye-Kelly* standard because the methods of calculation were not generally accepted,¹⁴⁸ but as methods have

141. *Id.* at 620. The majority of *Frye* courts “admit both match and population frequency evidence, with a minority of courts allowing only the match evidence, and an even smaller minority allowing neither the population frequencies nor the match evidence when they are uncoupled.” *Id.*

142. *Id.* at 618. The debate is over whether or not the calculation of population frequencies has been generally accepted by the relevant scientific community. *Id.*

143. *Id.* at 619 (citing *United States v. Yee*, 134 F.R.D. 161, 181 (N.D. Ohio 1991) (“[W]ithout the probability assessment, the jury does not know what to make of the fact that the patterns match: the jury does not know whether the patterns are as common as pictures with two eyes, or as unique as the Mona Lisa.”)). Due to the NRC report, “which states that without frequencies, the match is meaningless,” some courts “have found that if the statistics are not admissible, then the match evidence has no meaning and should not be admitted into evidence either.” *Id.*

144. Riley, *supra* note 127, at 619.

145. See discussion *supra* Part I.D.2.

146. Omura, *supra* note 89, at 333. In order to meet this additional criterion, only a limited hearing is required in which the proponent must make only a “foundational showing that the correct procedures were used.” *People v. Hill*, 107 Cal. Rptr. 2d 110, 117 (Ct. App. 2001) (quoting *People v. Barney*, 10 Cal. Rptr. 2d 731 (Ct. App. 1992)). Furthermore, the general acceptance of DNA testing procedures “may be established by the testimony of a director or supervisor of a DNA forensic lab.” *Id.* at 118.

147. Fleming, *supra* note 80, § 4 (2009) (citing CAL. EVID. CODE § 402 (West 1995); *Hill*, 107 Cal. Rptr. 2d 110 (Ct. App. 2001)). Despite the general acceptance of the testing procedures, *Frye-Kelly* courts will exclude evidence derived from these tests if the tests “were inadequately applied.” Margann Bennett, *Admissibility Issues of Forensic DNA Evidence*, 44 U. KAN. L. REV. 141, 170 (1995).

148. See Garrett E. Land, *Judicial Assessment or Judicial Notice? An Evaluation of the Admissibility Standards for DNA Evidence and Proposed Solutions to Repress the Current Efforts to Expand Forensic*

improved over time, this evidence is now admissible in the vast majority of *Frye-Kelly* courts.¹⁴⁹ Other *Frye-Kelly* courts have found that errors and acceptance regarding DNA statistical and match evidence goes to the weight of the evidence, not the admissibility.¹⁵⁰

3. *DNA Evidence Under the Daubert Standard*

Federal courts are bound by the *Daubert* standard and several states have chosen to adopt this standard of admissibility as well.¹⁵¹ DNA testing procedures are likely to be upheld in *Daubert* jurisdictions because they are capable of being tested (and have been tested), have been “subjected to substantial peer review and publication,” and most courts have determined that questions regarding the rate of error effect the weight of the evidence rather than its admissibility.¹⁵²

Of the federal circuit courts, several have taken judicial notice of the general reliability of both DNA testing techniques and statistical testing results.¹⁵³ Other circuit courts have found match and population DNA evidence to be admissible under *Daubert*.¹⁵⁴ Some states have held that the reliability requirement of *Daubert* calls for “a preliminary hearing to determine if the testing procedures used . . . were reliable.”¹⁵⁵ Of the states that have accepted the *Daubert* standard, only one has rejected DNA statistical evidence.¹⁵⁶ The

DNA Capabilities, 9 J. MED. & L. 95, 111 (2005) (citing *People v. Barney*, 8 Cal.App.4th 798, 822 (1992)).

149. See 29 AM. JUR. 2d *Evidence* § 1034 (2010).

150. Bennett, *supra* note 147, at 171.

151. Riley, *supra* note 127, at 621–22.

152. Valdivieso, *supra* note 126, at 1020–21.

153. Riley, *supra* note 127, at 622. The Second Circuit noted that courts could take judicial notice of the reliability of the DNA testing techniques employed by the FBI to calculate population frequencies. *Id.* The Eighth Circuit similarly concluded that “courts can take judicial notice of the reliability of the general theory and techniques of DNA profiling, which includes both match and population frequencies.” *Id.*

154. *Id.* The Ninth and Tenth Circuits have admitted DNA evidence that was tested using the FBI’s technique for calculating population frequencies. *Id.*

155. Bennett, *supra* note 147, at 171 (citing *United States v. Martinez*, 3 F.3d 1191, 1197–98 (8th Cir. 1993)).

156. See Riley, *supra* note 127, at 622. The Vermont Supreme Court denied the admissibility of population frequency evidence using FBI calculation techniques but stated that had the more conservative ceiling principle been used for calculation, the evidence would have been admissible. *Id.* at

majority of states employing *Daubert* have admitted both match and statistical DNA evidence.¹⁵⁷ Overall, it is easier to have DNA evidence admitted under *Daubert* than *Frye*.¹⁵⁸

B. The Fate of Newer Forms of Forensic Evidence Under the Current Admissibility Standards

Brain imaging is a relatively new form of forensic evidence that includes functional magnetic resonance imaging (fMRI), positive emission tomography (PET), single photon emission computed tomography (SPECT), and “brain fingerprinting” (BF).¹⁵⁹ While brain-imaging evidence is still widely debated and admissibility varies by jurisdiction,¹⁶⁰ its treatment as a new science by courts demonstrates the need to rethink the current treatment of DNA evidence in courtrooms now that technology has been developed to fabricate DNA evidence.

Brain-imaging evidence has been offered in courtrooms to (1) show brain structure that is irregular or damaged; (2) show the cause for a particular type of injury (issues regarding brain function); (3) explain or predict future behavior; and (4) assert that someone is lying.¹⁶¹ The admissibility of lie detection evidence is the most

622–23. The Delaware Supreme Court found that where match evidence meets all the criteria under *Daubert* but the population frequency evidence does not, neither is admissible. *Id.* at 623.

157. *Id.* Many state courts prefer a method known as the “ceiling principle” in calculating population frequencies because it is considered more conservative and minimizes the risk of error. *Id.* at 622. The ceiling principle uses “the highest allele frequency in any subgroup or 5%, whichever is higher,” as a basis for the calculation of DNA population statistics. LAWRENCE KOBILINSKY ET AL., DNA: FORENSIC AND LEGAL APPLICATIONS 155 (2005).

158. Riley, *supra* note 127, at 624.

159. Mark Pettit, Jr., *fMRI and BF Meet FRE: Brain-Imaging and the Federal Rules of Evidence*, 33 AM. J.L. & MED. 319, 319–21 (2007). fMRI, PET scans, and SPECT scans track brain function over time. *Id.* at 320. fMRI “involves making a series of brain images to show changes in blood levels” in different parts of the brain over time. *Id.* PET and SPECT scans use radioactivity to track changes in brain function. *Id.* BF, on the other hand, “uses EEG (electroencephalographic) sensors to record electric brain signals emitted when subjects encounter various stimuli.” *Id.* at 321.

160. See discussion *infra* Part II.B.

161. Pettit, *supra* note 159, at 321–23. fMRI and BF technologies “are being developed specifically for the purpose of detecting lies.” *Id.* at 323. The theory behind fMRI lie detection is that the blood levels imaged “show how hard the brain is working and that lying takes more ‘brain work’ than telling the truth.” *Id.* at 320. BF asserts that by examining multiple EEG responses to stimuli, it can determine whether or not the subject has encountered the stimuli before. *Id.* at 321. “Thus, BF purports to be able

heavily debated, while cases involving brain structure or function are more likely to be admitted.¹⁶² Brain-imaging evidence has been admitted in some *Daubert* and *Frye* courts.¹⁶³ Still, critics argue that brain-imaging should not be admissible under either standard, and many *Daubert* and *Frye* courts have refused to admit this type of evidence.¹⁶⁴

Some states have been more receptive to brain-imaging than others.¹⁶⁵ Additionally, the admissibility of brain-imaging evidence tends to be largely dependent on the purpose for which the evidence is sought to be admitted.¹⁶⁶ In *Frye* courts, the admissibility of brain-imaging evidence may also be highly dependent on what the court defines as the “relevant scientific community.”¹⁶⁷ Brain-imaging evidence has had more difficulty in courts following *Daubert* because of the “closer judicial scrutiny of the scientific basis for psychiatric diagnoses.”¹⁶⁸ Because fMRI evidence is extremely new, it has not been seen in court as frequently as other brain-imaging evidence, and it will likely have the most difficulty being admitted.¹⁶⁹

to determine whether the brain gives an ‘information present’ or ‘information absent’ response to a particular stimulus.” *Id.*

162. See *id.* at 321–23; Michael L. Perlin, “His Brain Has Been Mismanaged With Great Skill”: How Will Jurors Respond to Neuroimaging Testimony in Insanity Defense Cases?, 42 AKRON L. REV. 885, 894 (2009).

163. O. Carter Snead, *Neuroimaging and the “Complexity” of Capital Punishment*, 82 N.Y.U. L. REV. 1265, 1291 n.125 (2007).

164. *Id.* at 1272 n.25.

165. Feigenson, *supra* note 124, at 237.

166. See *id.* For example, courts in California, which follow the *Frye-Kelly* standard, have found that PET scans are generally acceptable for use in cases of Alzheimer’s, strokes, and epilepsy, but not for diagnosing head trauma or other conditions. *Id.* New York courts have also failed to admit brain-imaging evidence for the purpose of diagnosing head trauma. *Id.* at 237–38. Louisiana, on the other hand, has admitted brain-imaging for the purpose of diagnosing or evaluating head trauma. *Id.* at 237.

167. Jennifer Kulynych, *Psychiatric Neuroimaging Evidence: A High-Tech Crystal Ball?*, 49 STAN. L. REV. 1249, 1263 (1997).

168. *Id.* However, the Eight Circuit recognized that “[t]here is . . . no question that the PET scan is scientifically reliable for measuring brain function.” Pettit, *supra* note 159, at 337 (quoting *Hose v. Chicago Nw. Transp. Co.*, 70 F.3d 968, 973 (8th Cir. 1995)). But see *Penney v. Praxair, Inc.*, 116 F.3d 330, 334 n.5 (8th Cir. 1997) (affirming the exclusion of PET scan evidence, stating that “the admission of scientific evidence in one case does not automatically render that evidence admissible in another case”).

169. See Brian Reese, *Using fMRI as a Lie Detector—Are We Lying to Ourselves?*, 19 ALB. L.J. SCI. & TECH. 205, 216–19 (2009) (finding that due to the lack of sufficient data, lack of “consensus in the scientific community as to the technology’s reliability, or even validity,” and the possible prejudicial affect on juries and judges, fMRI technology will likely have difficulty passing under *Daubert* and the

Of the courts that have admitted brain-imaging evidence, some have been criticized for “abdicat[ing] their evidentiary screening function.”¹⁷⁰ In *People v. Weinstein*,¹⁷¹ a *Frye* court held “that a psychiatric witness could present PET scan evidence if the witness had relied upon it in forming his diagnosis,” even though there was no showing that the evidence was “generally accepted within the scientific community.”¹⁷² One critic has suggested that “[t]he judge in *Weinstein* may have been seduced by defense rhetoric and [brain-imaging’s] high-tech glamour.”¹⁷³ Other courts have recognized the risk that juries will be misled by the high-tech imagery, causing them to “overestimate its probative value and obscure its merely conjectural nature.”¹⁷⁴ One study found that brain-imaging evidence is more likely to be admitted in a bench trial, attributing this to that fact that in a bench trial, “there is no jury to protect from evidence deemed insufficiently reliable.”¹⁷⁵ Additionally, brain-imaging evidence is most often admitted when corroborated with other “neurological and clinical evidence.”¹⁷⁶

One of the greatest concerns regarding fMRIs and other brain-imaging evidence is that they “may offer convincing evidence because they look like what people expect images of the brain to look like, because they have seen brain images in magazines, on television and on the Internet.”¹⁷⁷ Non-scientists, especially jurors, may be tempted to find this sort of evidence credible despite the lack of general consensus on the reliability of this type of evidence within

Federal Rules of Evidence). *But see* Charles N.W. Keckler, *Cross-Examining the Brain: A Legal Analysis of Neural Imaging for Credibility Impeachment*, 57 HASTINGS L.J. 509, 540–42 (2006) (asserting that fMRI research “would be ‘generally accepted’ under the *Frye* standard” because it is common in the relevant field of cognitive neuroscience, but that the error rate at the current time “would be unacceptably high for admissibility” under *Daubert*).

170. Kulynych, *supra* note 167, at 1262.

171. *People v. Weinstein*, 591 N.Y.S.2d 715 (Sup. Ct. 1992).

172. Kulynych, *supra* note 167, at 1262 (citing *Weinstein*, 591 N.Y.S.2d at 723).

173. *Id.*

174. *Id.* at 1263 (quoting *People v. Burton*, 590 N.Y.S.2d 972, 978 (Sup. Ct. 1992)).

175. Feigenson, *supra* note 124, at 237.

176. *Id.* at 238.

177. *Id.* at 247 (emphasis omitted).

the scientific community.¹⁷⁸ Thus, “the potential for undue prejudice” is especially great with this type of forensic evidence.¹⁷⁹

C. Acceptance of DNA Greatly Differs from the Courts’ Reception of Brain-Imaging Evidence

The almost blanket judicial acceptance of DNA evidence¹⁸⁰ is a sharp contrast to the cautious, skeptical approach that brain-imaging evidence faces today.¹⁸¹ Even in the early years of DNA evidence, there was support for unquestioned acceptance of DNA evidence: “Questions about the validity of DNA typing—either the knowledge base supporting technologies that detect genetic differences or the underlying principles of applying the techniques per se—are red herrings that do the courts and the public a disservice.”¹⁸² Additionally, in 1987 in one of the earliest criminal cases involving DNA evidence, a defendant in a Florida court was convicted of rape and burglary entirely on the basis of DNA evidence.¹⁸³

Unlike the near universal acceptance of DNA by the legal system, the courts have been more wary with newer forms of forensic evidence like brain-imaging.¹⁸⁴ While courts have “not categorically reject[ed] brain-imaging evidence . . . they seek to ensure that the science adequately supports the claims that the proponents are

178. *See id.*

179. Laura Stephens Khoshbin & Shahram Khoshbin, *Imaging the Mind, Minding the Image: An Historical Introduction to Brain Imaging and the Law*, 33 AM. J.L. & MED. 171, 186 (2007).

180. *See* discussion *supra* Part II.A.

181. *See* discussion *supra* Part II.B.

182. Bennett, *supra* note 147, at 152 (quoting U.S. Congress, Office of Technology Assessment, Genetic Witness: Forensic Uses of DNA Tests 8 (1990)).

183. Anthony Pearsall, *DNA Printing: The Unexamined “Witness” in Criminal Trials*, 77 CAL. L. REV. 665, 690–91 (1989). In 1987, Tommie Lee Andrews was convicted of burglary and rape, becoming “the first person in the United States to be convicted on the basis of DNA.” *Id.*; *see* *State v. Andrews*, No. 87-1659, (Fla. Cir. Ct. (Orange County) Nov. 1987), *aff’d*, *Andrews v. State*, 533 So. 2d 841 (Fla. Dist. Ct. App. 1988). Andrews “maintain[ed] his innocence throughout his trials . . . [and] [t]he prosecution offered no witnesses to counter Andrews’ alibi except the victim, who could not identify Andrews’ face or voice.” Pearsall, *supra* note 183, at 690–91. Additionally, “[t]he results of traditional blood and semen typing were insufficient to link Andrews to the crime.” *Id.* at 691. Despite this, DNA testing by a lab “concluded that the rapist’s DNA matched that of Andrews.” *Id.* Based on this, Andrews was “convicted and sentenced to twenty-two years in prison.” *Id.*

184. *See* discussion *supra* Part II.B.

making for the evidence.”¹⁸⁵ Brain-imaging evidence has been primarily denied admissibility based on fear of prejudice and lack of reliability.¹⁸⁶ Courts encountering brain-imaging evidence are more likely to admit the evidence when there is no jury—and thus less of a chance of prejudice—and where there is corroborating evidence.¹⁸⁷ DNA evidence has also faced these challenges, but the courts have been far more willing to let the evidence in unchecked.

While courts that have admitted brain-imaging evidence have been criticized for “abdicat[ing] their evidentiary screening function,”¹⁸⁸ many courts faced with DNA evidence have found that issues regarding the performance of DNA testing and the scientific acceptance of the evidence go to the weight of the evidence, not the admissibility, essentially relinquishing evidentiary screening to the jury.¹⁸⁹ Additionally, brain-imaging evidence tends to be admitted or excluded on a case-by-case basis by examining the specific facts of the case and purpose for which the evidence is sought to be admitted.¹⁹⁰ In contrast, many courts evaluating DNA evidence have declared DNA testing techniques and results judicially noticeable, and therefore these courts do not perform any preliminary determination of the reliability of DNA evidence.¹⁹¹

As with brain-imaging evidence, there is also a concern with DNA evidence “that a jury might give it more weight than it should.”¹⁹² One court described statistical DNA evidence as a “method of scientific proof . . . so impenetrable that it [will] assume a posture of mystic infallibility in the eyes of a jury.”¹⁹³ Still, this has not kept DNA evidence out of courts. Additionally, despite numerous incidents of tampering with DNA evidence,¹⁹⁴ courts have allowed

185. Pettit, *supra* note 159, at 339.

186. See Feigenson, *supra* note 124, at 238, 247; Kulynych, *supra* note 167, at 1262.

187. Feigenson, *supra* note 124, at 237–38.

188. Kulynych, *supra* note 167, at 1262.

189. Imwinkelried, *supra* note 79, at 20–21.

190. Feigenson, *supra* note 124, at 237.

191. See Fleming, *supra* note 80, § 2(d) (citing *Zack v. State*, 911 So. 2d 1190 (Fla. 2005)); Imwinkelried, *supra* note 79, at 20–21.

192. Land, *supra* note 148, at 111.

193. *Id.* (quoting *People v. Barney*, 10 Cal. Rptr. 2d 731, 742 (1992)).

194. See discussion *supra* Part I.C.3.

DNA evidence to be admitted before juries without corroborating evidence.¹⁹⁵ With the possibility of DNA fabrication now available, the reliability of DNA evidence is even more insecure. How will courts—more importantly—how should courts handle the future admissibility of DNA evidence?

D. Predictions of the Future of DNA Evidence After the Nucleix Findings

Even with the discovery of the ability to easily fabricate DNA evidence, courts are unlikely to discontinue their current treatment of DNA evidence. The many previous incidents of DNA falsification¹⁹⁶ have not swayed the courts' general acceptance of DNA. Furthermore, due to the many successes of DNA technology in law enforcement,¹⁹⁷ courts may be reluctant to turn their backs on DNA evidence. DNA evidence is a powerful law enforcement tool, and it should not be abandoned or ignored.¹⁹⁸ However, the possibility of the misuse of DNA evidence is now even greater with the ability to easily fabricate DNA, which suggests a more cautious approach to DNA evidence is in order.

III. PROPOSAL

A. Addressing the Admissibility of DNA Evidence in Court

1. Frye-Kelly Standard is Best Suited for Determining the Admissibility of DNA Evidence

Although all federal courts and several state courts currently follow *Daubert*, this standard has been criticized for failing to

195. See generally Malcom, *supra* note 10.

196. See discussion *supra* Part I.C.3.

197. DNA evidence is responsible for the post-conviction exoneration of over 230 innocent persons as of 2009. Garrett & Neufeld, *supra* note 5, at 5. Additionally, DNA profiles from CODIS have assisted in over 36,000 investigations, many of which resulted in successful prosecutions. Peterson & Leggett, *supra* note 4, at 653–54.

198. In fact, it has been suggested that denying the admissibility of forensic evidence would unfairly prejudice the proponent of the evidence since jurors now have high expectations regarding scientific evidence and what it should look like. See Feigenson, *supra* note 124, at 250.

“sufficiently address reliability issues” and for providing guidelines that are “vague and unhelpful to courts.”¹⁹⁹ Additionally, the *Daubert* standard and guidelines “require that judges make extremely technical determinations that they may not be qualified to make.”²⁰⁰ Data collected from a 2001 survey of judges suggested that most judges do not even understand the key elements of the *Daubert* decision.²⁰¹

Frye, on the other hand, “leav[es] judicial decisions to the judge[s] and scientific determinations to the scientists.”²⁰² *Frye* is considered a stricter standard of admissibility—better equipped to “counter scientific and statistical evidence, which tends to have an ‘aura of infallibility.’”²⁰³ However, as time has passed and DNA evidence has now met the “general acceptance” standard in nearly all jurisdictions,²⁰⁴ a reliability requirement that “effectively individualizes each case and protects defendants from evidence which may have been obtained using faulty laboratory practices,” should be implemented as well.²⁰⁵ The third prong of the *Frye-Kelly* standard best satisfies this reliability factor by requiring the proponent to show that the correct scientific procedures were used for a particular case and that they are generally accepted in the scientific community.²⁰⁶

199. Bennett, *supra* note 146, at 172.

200. *Id.*

201. Peterson & Leggett, *supra* note 4, at 642–43 (citing Sophia I. Gatowski et al., *Asking the Gatekeepers: A National Survey of Judges on Judging Expert Evidence in a Post-Daubert World*, 25 LAW & HUM. BEHAV. 433, 443 (2001)). The 2001 research article on whether “judges truly understand the *Daubert* decision,” surveyed 400 state court judges. *Id.* at 642 (citing Gatowski et al., *supra* note 201, at 434). When the judges “were asked to operationalize several of the key concepts of expressed in *Daubert*, they could not.” *Id.* at 643 (citing Gatowski et al., *supra* note 201, at 443). Of the judges surveyed, “[o]nly six percent . . . demonstrated a good understanding of the concept of ‘falsifiability,’ and just four percent had a clear understanding of error rate.” *Id.* (citing Gatowski et al., *supra* note 201, at 444, 447).

202. Bennett, *supra* note 146, at 172.

203. *Id.* (citing *State v. Bible*, 858 P.2d 1152, 1183 (Ariz. 1993)).

204. See discussion *supra* Part II.A.1.

205. Bennett, *supra* note 147, at 173.

206. Omura, *supra* note 89, at 333; see MICHAELIS ET AL., *supra* note 6, at 216. A New York court also applied a modified *Frye* test for DNA evidence with a third prong similar to the *Frye-Kelly* standard asking whether “the testing laboratory perform[ed] the accepted scientific techniques in analyzing the forensic samples in [the] particular case.” Bennett, *supra* note 147, at 171; see *People v. Castro*, 545 N.Y.S.2d 985, 987 (Sup. Ct. 1989).

2. *DNA Evidence Should be Admitted Cautiously on a Case-by-Case Basis*

Although some interpret the third prong of the *Frye-Kelly* standard only to require use of the correct scientific procedures, courts should interpret this prong to require not only use of “correct” scientific procedures but also their correct application.²⁰⁷ Even if the “correct” scientific procedures are used and the sample is genuine, “human involvement creates the potential for inaccurate results.”²⁰⁸ By ensuring that the techniques are correctly applied in each case, courts will admit more reliable DNA evidence.

Additionally, in many jurisdictions—including *Frye-Kelly* jurisdictions—courts have held that the “inquiry into laboratory performance . . . go[es] toward the weight of the evidence.”²⁰⁹ Deficiencies in DNA typing analysis and errors in match and statistical DNA evidence should not go to the weight of the evidence but rather to its admissibility. Simply educating jurors on the flaws in DNA evidence and asking them to give less weight to certain DNA evidence may not be adequate. In a 2000 study, researchers simulated trials using DNA evidence, and during the study, mock jurors convicted a defendant based on DNA evidence despite “a defense expert who highlighted the problems with DNA evidence, saying it was ‘not an exact science and that mistakes and contamination of the evidence can occur anywhere in the process.’”²¹⁰ By putting this issue before the judge instead of the jury, courts will reduce the potential prejudicial effect unreliable DNA evidence may have on jurors.²¹¹

207. The California Court of Appeals has interpreted the third prong of the *Frye-Kelly* test this way. Kramer, *supra* note 94, at 168–69.

208. Joel D. Lieberman et al., *Gold Versus Platinum: Do Jurors Recognize the Superiority and Limitations of DNA Evidence Compared to Other Types of Forensic Evidence?*, 14 PSYCHOL. PUB. POL’Y & L. 27, 45 (2008).

209. Bennett, *supra* note 147, at 171; see discussion *supra* Part II.A.

210. Lieberman et al., *supra* note 208, at 32–33 (quoting Jonathan. M. Golding et al., *The Impact of DNA Evidence in a Child Sexual Assault Trial*, 5 CHILD MALTREATMENT 373, 376 (2000)).

211. See discussion *supra* Part I.E.

B. Additional Requirements

In addition to following the three-prong test set forth by *Frye-Kelly* when deciding the admissibility of DNA evidence, courts should also implement other measures to ensure the reliability of the DNA evidence.

1. The Need for DNA Authentication

The Nucleix research demonstrates the need to implement DNA authentication measures before admitting DNA evidence into court.²¹² The researchers note that authentication measures are both costly and time-consuming,²¹³ so the question becomes, who should be responsible for performing the tests and bearing the costs? The Nucleix researchers suggest that “develop[ing] an integrated DNA authentication assay that will be performed in existing forensic laboratories, as part of the regular forensic procedure” would “reduce costs and possible backlogs.”²¹⁴

Another possibility would be to place the burden on the party challenging the DNA evidence. Up until now, courts have operated under the assumption that the DNA evidence parties sought to admit consisted of genuine samples of human DNA.²¹⁵ As we now know, this may no longer be true.²¹⁶ An alternative to incorporating the costly DNA authentication procedures into the traditional procedures of DNA analysis would be for courts to start with a presumption that the DNA evidence is genuine, and place the burden on the party challenging the DNA evidence to prove that it is artificial.²¹⁷ Courts

212. See discussion *supra* Part I.B.

213. See Frumkin et al., *supra* note 1, at 8.

214. *Id.*

215. *Id.* at 1.

216. See discussion *supra* Part I.B.

217. Because the defendant will likely be the party challenging the DNA evidence and thus have the burden of proving the DNA evidence is false, some might assert that this method will place too great of a financial burden on the defendant when the prosecution is arguably better equipped to bear the costs. However, because defendants know whether or not they actually committed the crimes in question, they are in the best position to know whether or not authenticating the DNA evidence is necessary; if the defendant committed the crime, the sample is likely genuine, so the defendant will not have to waste time or money on authentication procedures that will not help the defense's case.

should be reluctant to admit uncorroborated DNA evidence in cases where it has not been authenticated.²¹⁸

2. The Need for Independent Forensic Laboratories with Better Trained and Qualified Forensic Analysts

Despite the many instances of DNA falsification in forensic laboratories,²¹⁹ “crime laboratories and forensic analysts remain remarkably free from oversight.”²²⁰ In addition to the incidents of intentional falsification, proficiency testing has shown “that a disturbingly high percentage of laboratories are not performing routine tests competently.”²²¹ Forensic laboratories are prone to errors mainly because they lack sufficient staff, work with out-of-date technology, and face enormous DNA backlogs.²²² Additionally, many forensic practitioners are “scientifically ignorant”; forensic analysts are inadequately trained and “[t]he forensic science profession lacks minimum education standards for its personnel.”²²³

In order to address these concerns, supporters of forensic reform assert that hundreds of millions of dollars in funding is necessary for DNA testing to address massive backlogs, crime lab modernization, and hiring of additional forensic analysts.²²⁴ Additionally, training

218. This will also help alleviate the concerns of those who fear that an indigent innocent defendant will not be able to afford authentication procedures for the DNA evidence.

219. See discussion *supra* Part I.C.3.

220. Garrett & Neufeld, *supra* note 5, at 94.

221. Cooley, *supra* note 50, at 392. In addition to the Houston Police Department’s crime lab, discussed *supra* Part I.C.3., crime labs in Arizona, California, Colorado, Florida, Illinois, Indiana, Kansas, Nevada, Pennsylvania, and West Virginia have seen misconduct and gross ineptness that have called into question numerous laboratory results and criminal convictions. See *id.* at 413–16.

222. See *id.* at 419–20.

223. *Id.* at 424. Undergraduate programs in forensic science provide only a general overview of forensic science and rarely include laboratory work. Cooley, *supra* note 122, at 482. Even for those individuals that earn a graduate degree in forensic science, their “understanding of science and the scientific method [likely] still pale in comparison to that of traditional scientists because ‘it is possible to earn a [Masters in Forensic Science] without ever having set foot in a laboratory or even having taken a core curriculum of hard science classes.’” *Id.* (quoting Keith Inman & Norah Rudin, PRINCIPLES AND PRACTICE OF CRIMINALISTICS: THE PROFESSION OF FORENSIC SCIENCE 303–04 (2001)).

224. See Cooley, *supra* note 50, at 419–20. In 1999, a study asserted that “an additional 9,000 forensic scientists are needed to properly staff the nation’s laboratories [which] would cost more than \$640 million.” *Id.* at 419 (citing NATIONAL INSTITUTE OF JUSTICE, FORENSIC SCIENCES: REVIEW OF STATUS AND NEEDS (1999)). Additionally, the study revealed that \$1.3 billion would be needed for “satisfactory laboratory facilities, and \$285 million [would be] needed to purchase equipment necessary to analyze

and education in the scientific method as well as hands-on laboratory experience and a “demanding physical science curriculum” should be required for forensic analysts.²²⁵ The scientific community should also implement national standards that “ensure[] that all analysts adhere to standards for permissible scientific conclusions regarding forensic evidence.”²²⁶ Although this may alleviate mishaps and errors in forensic labs, it probably will not stop the intentional falsification of evidence.

Some attribute the corrupt and fraudulent conduct among many forensic scientists to the relationship between the forensic science community and law enforcement.²²⁷ Perhaps the greatest concern is that currently “the overwhelming majority of ‘forensic examinations are conducted in government-funded laboratories, usually located within law enforcement agencies, and typically for the purpose of building a case for the prosecution.’”²²⁸ As a result, many forensic and crime laboratory employees have developed a police-prosecution bias, which results in a “willing[ness] to circumvent true scientific investigation methods” in order to support the police’s or prosecution’s case.²²⁹ Additionally, the 2009 National Academy of Science Report reported that “the majority of forensic science laboratories are administered by law enforcement agencies, such as police departments, where the laboratory administrator reports to the head of the agency,” which raises significant concerns regarding the independence of these laboratories.²³⁰

submitted evidence.” *Id.* Ten years later, the need, as well as the cost, is likely greater. While an overhaul of forensic science laboratories will require a substantial amount of money, given that the lives and liberty of American citizens are at stake, this cost is necessary and justified.

225. *See id.* at 425–26.

226. Garrett & Neufeld, *supra* note 5, at 11 (“Currently, no national or widely accepted set of standards for forensic science written reports or testimony exists.”).

227. Cooley, *supra* note 50, at 408.

228. *Id.* (quoting John I. Thornton & Joseph L. Peterson, *The General Assumptions and Rationale of Forensic Identification*, in *SCIENCE IN THE LAW: FORENSIC SCIENCE ISSUES* 1, 2 (David L. Faigman et al. eds., 2d ed. 2002)).

229. *Id.* (quoting Andrea A. Moenssens, *Novel Scientific Evidence in Criminal Cases: Some Words of Caution*, 84 J. CRIM. L. & CRIMINOLOGY 1, 6 (1993)).

230. COMM. ON IDENTIFYING THE NEEDS OF THE FORENSIC SCI. CMTY., COMM., NAT’L RESEARCH COUNCIL, *STRENGTHENING FORENSIC SCIENCE IN THE UNITED STATES: A PATH FORWARD* 183–84 (2009).

In order to reduce the pro-police bias that crime laboratory technicians may have, forensic testing for criminal investigations should be conducted by independent forensic laboratories. The use of independent crime laboratories would serve two goals: it “would level the playing field with respect to defendants and the state when it comes to accessing forensic experts,” and it would “decrease the interaction between forensic practitioners, prosecutors, and investigators,” thus reducing prosecutorial bias.²³¹ In addition to the use of independent laboratories, DNA examiners should be given “unknown samples and controls to avoid unintentional bias.”²³² By eliminating the connection with police and removing biasing information that could lead to false conclusions, forensic scientists will base their findings solely on the results of DNA testing procedures.²³³

CONCLUSION

The many successes of DNA-based evidence, as well as the glorified images of DNA testing and crime laboratories in forensic crime dramas on television, have resulted in DNA’s near infallible status.²³⁴ However, the discovery of the ability to easily fabricate DNA evidence as well as a long history of DNA falsification and gross ineptness by crime laboratories demonstrate that DNA-based evidence’s sterling reputation is undeserved.²³⁵ In order to address the growing concern of unreliable DNA evidence being admitted into courtrooms and prejudicing juries, courts should adopt the three-prong *Frye-Kelly* standard of admissibility for DNA evidence.²³⁶ Like with newer forms of forensic evidence such as brain-imaging,²³⁷

231. Cooley, *supra* note 50, at 423.

232. Lieberman et al., *supra* note 208, at 45. Currently, “many forensic labs receive transmittal letters with each sample submitted to the lab detailing the investigator’s version of the crime, assuming the suspect is guilty, and implying that the scientist merely needs to confirm what the detective already knows.” *Id.*

233. See Cooley, *supra* note 50, at 423.

234. See discussion *supra* Part I.E. and note 197.

235. See discussion *supra* Part I.C.3.

236. See discussion *supra* Parts I.D.2., III.A.

237. See discussion *supra* Part II.B.

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courts should evaluate DNA evidence on a case-by-case basis, evaluating the authenticity of the DNA evidence as well as the testing procedures used to obtain the results.

Additionally, DNA testing should be conducted by independent laboratories to eliminate police-prosecution bias.²³⁸ Thousands of additional forensic analysts, with the proper training and education, should be employed and held to a stringent national standard for forensic analysis.²³⁹ Lastly, DNA evidence authentication protocols should be implemented in courts nationwide.²⁴⁰ While individuals may continue to falsify forensic evidence in order to avoid criminal prosecution, these reform measures will reduce the use of unreliable DNA evidence in courts and the instances of forensic fraud and error by forensic analysts.

238. See discussion *supra* Part III.B.2.

239. See *supra* text accompanying notes 224–226.

240. See discussion *supra* Part III.B.1.

